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Technologies for waste heat recovery in offshore applications

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1 Motivation and background

With increasing incentives for reducing CO₂ emissions, energy optimization on offshore platforms becomes a focus area. The waste heat recovery from the SGT-500 SIEMENS gas turbine utilized on the Draugen platform (Kristiansund) is investigated. Three possible technologies are considered: the air bottoming cycle (ABC), the organic Rankine cycle (ORC) and the steam Rankine cycle (SRC). Thermal efficiency, compactness, weight and investment cost are the major constraints.

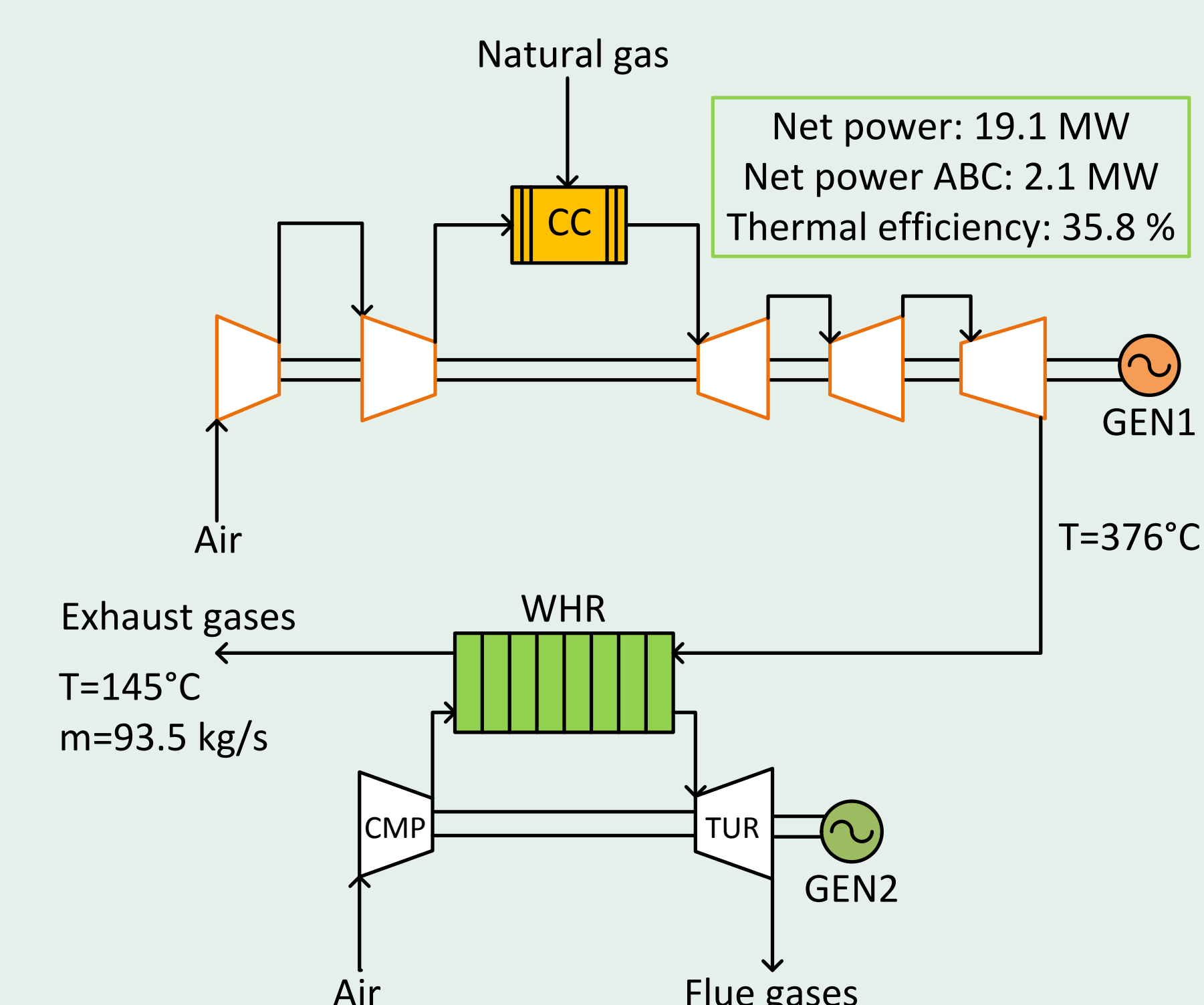


Figure 1: Plant layout including the SGT-500 gas turbine and air bottoming cycle

Air bottoming cycle

Pros:

- Simple layout (open cycle)
- No condenser is needed
- No intermediate loop
- Low hazard and environmental-friendly fluid

Cons:

- Low thermal efficiency
- Wide WHRU exchange area
- High turbine outlet temperature

Organic Rankine cycle

Pros:

- High thermal efficiency (up to 44.3%)
- Compactness
- No moisture at turbine outlet ("dry" fluid)
- Flexibility in the working fluid selection

Cons:

- Intermediate loop
- High fire hazard
- New technology

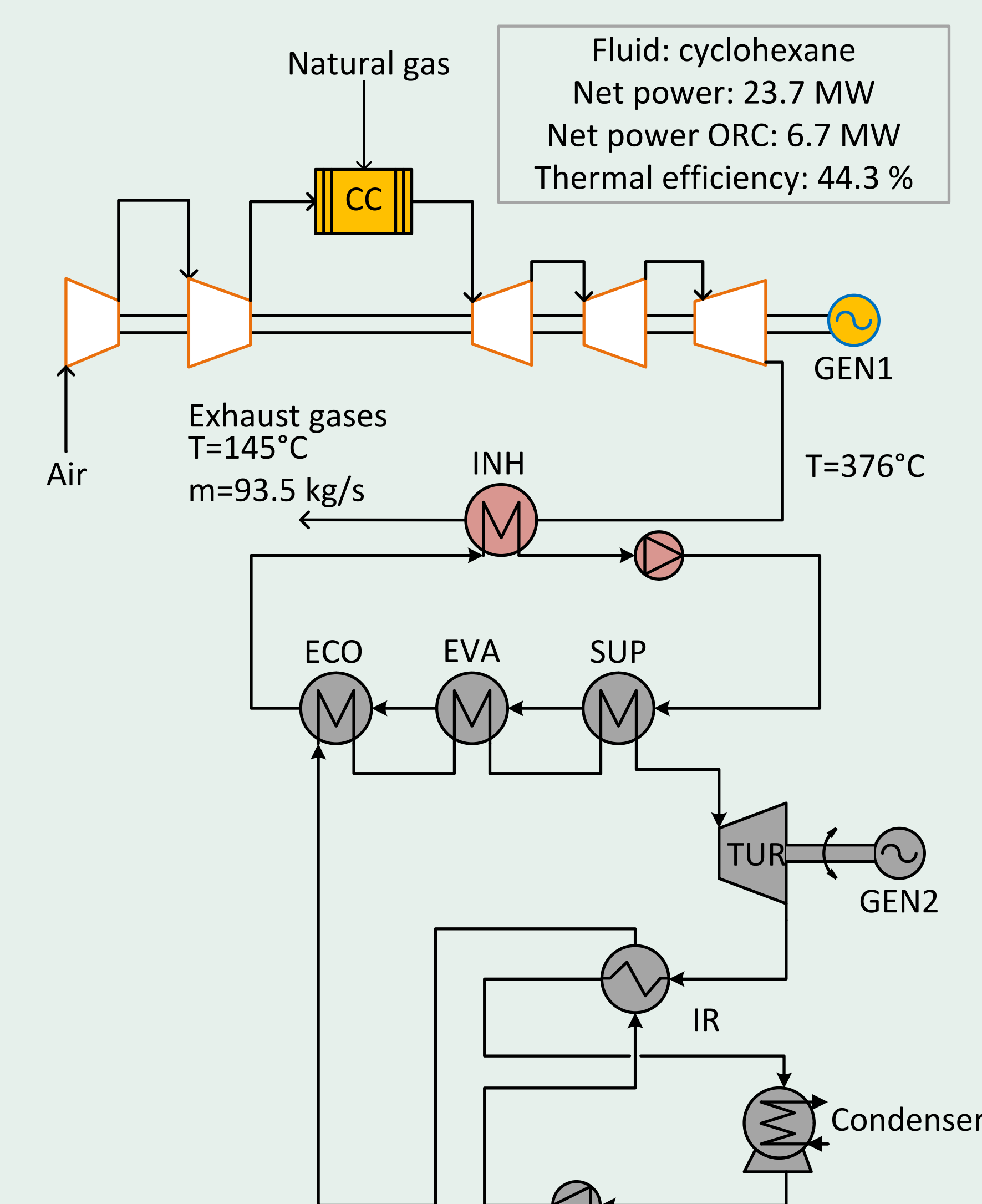


Figure 2: Plant layout including the SGT-500 gas turbine and organic Rankine cycle

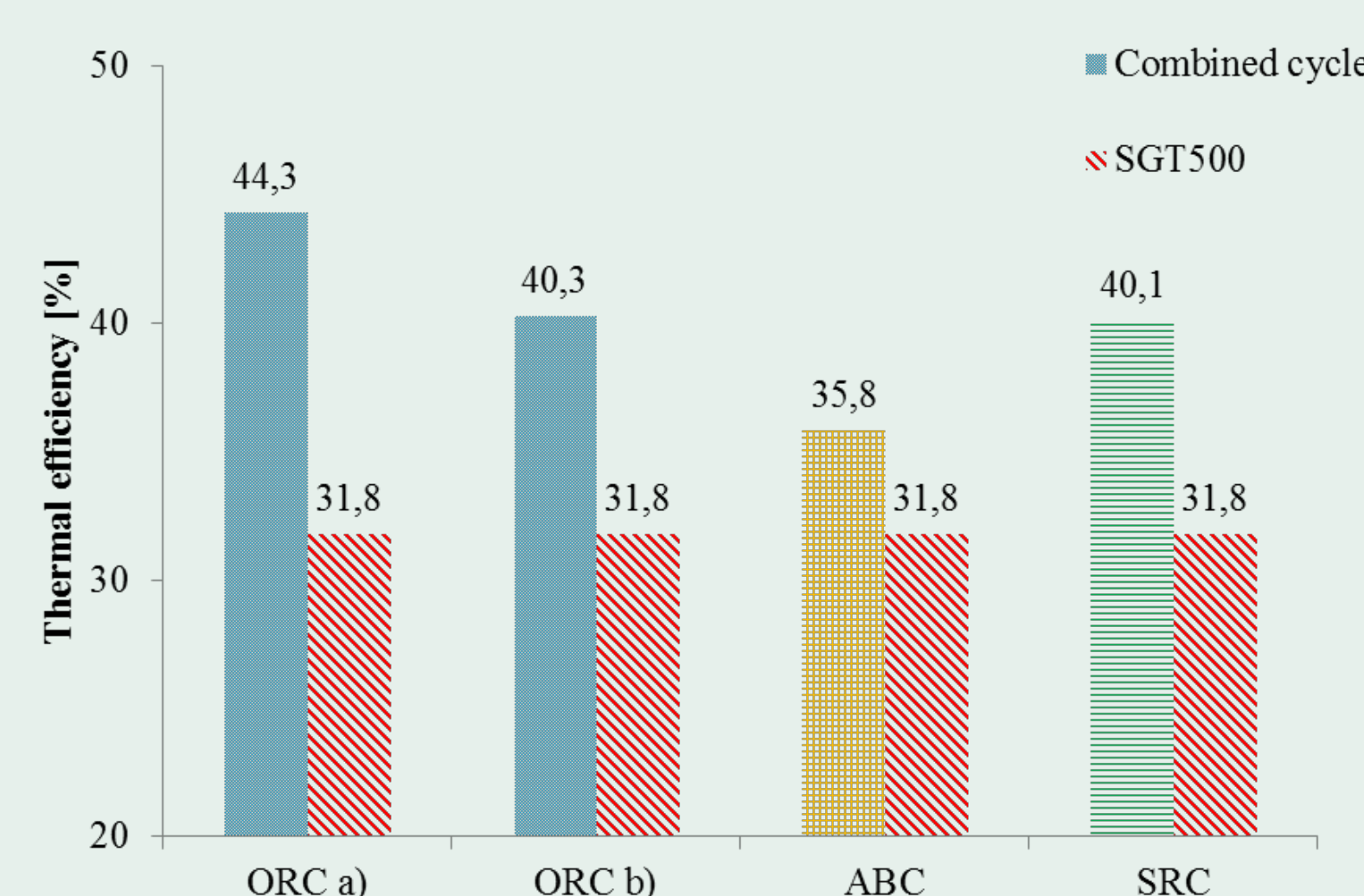


Figure 3: Comparison between the different waste heat recovery technologies

Steam Rankine cycle

Pros:

- Low maximum (10 bar) and high minimum pressures (0.1 bar)
- No intermediate loop
- Established technology
- Low hazard and environmental-friendly fluid

Cons:

- Low thermal efficiency
- Moisture at steam turbine outlet (5%)
- Need for make-up water

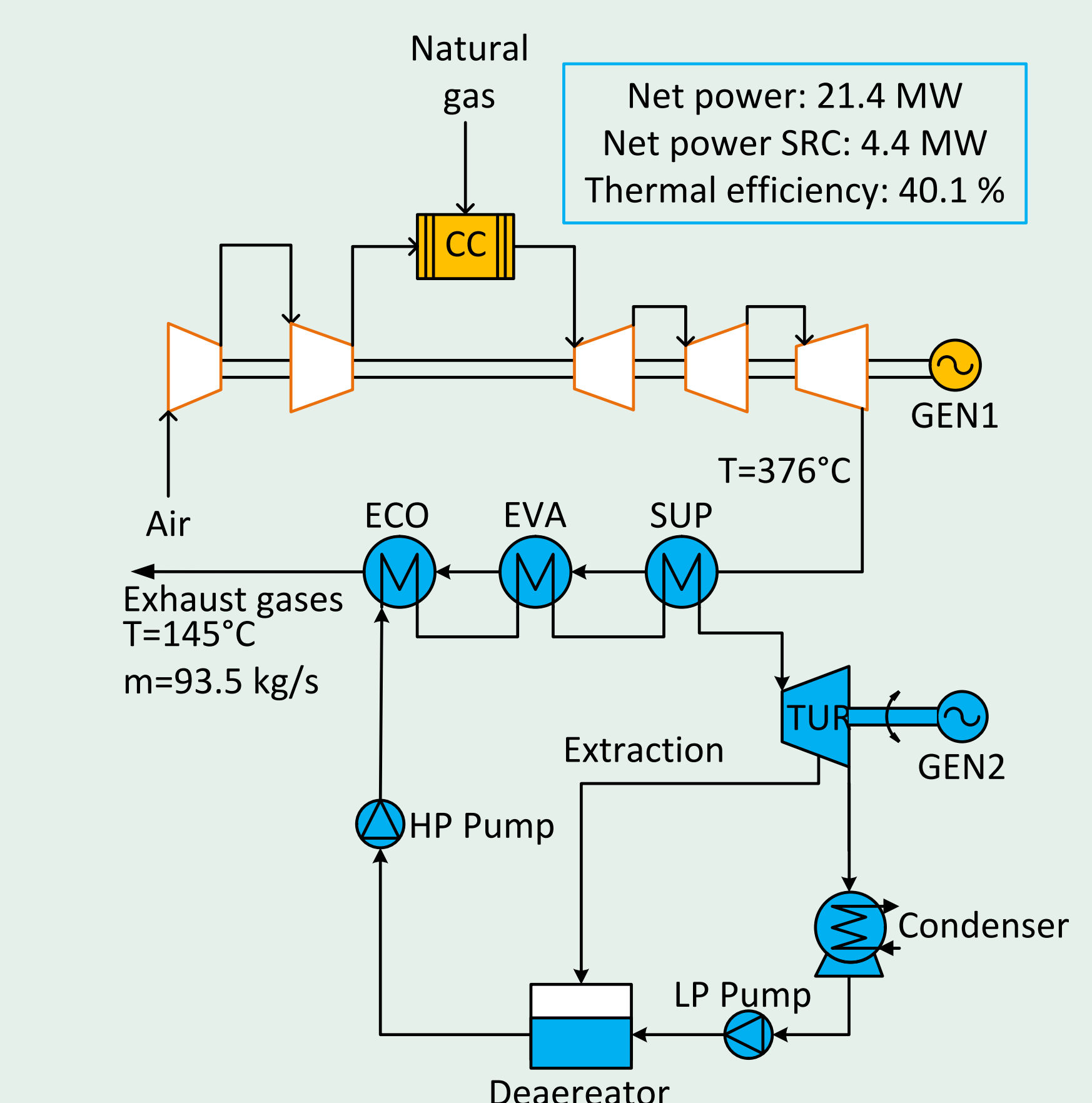


Figure 4: Plant layout including the SGT-500 gas turbine and steam Rankine cycle

2 Results and discussion

The combination of the SGT-500 and ORC presents the highest system performance (44.3%) with cyclohexane (case a). When a low fire hazard is required carbon dioxide is the preferable media (case b). The ABC exhibits the lowest overall efficiency (35.8%) due to the high outlet ABC turbine temperature (220°C). If a SRC is utilized problems related to moisture content after the expansion are encountered; combined cycle efficiency is 40.2%.

3 Acknowledgements

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